Multidimensional Poverty and Material Deprivation*

Walter Bossert
Department of Economics and CIREQ, University of Montreal
walter.bossert@umontreal.ca

Satya R. Chakravarty
Indian Statistical Institute, Kolkata
satya@isical.ac.in

Conchita D'Ambrosio
Università di Milano-Bicocca, DIW Berlin and Econpubblica, Università Bocconi
conchita.dambrosio@unibocconi.it

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Abstract

We examine the measurement of multidimensional poverty and material deprivation following the counting approach. In contrast to earlier contributions, dimensions of well-being are not forced to be equally important but different weights can be assigned to different dimensions. We characterize a class of individual measures reflecting this feature. In addition, we axiomatize an aggregation procedure to obtain a class of indices for entire societies allowing for different degrees of inequality aversion in poverty. We apply the proposed measures to European Union member states where the concept of material deprivation was initiated. *Journal of Economic Literature* Classification No.: D63.

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1 Introduction

An important development in the study of inequality and poverty in the recent past is the shift of emphasis from a single dimension, such as income, to a multidimensional framework. There are several reasons for this.

First, the influential work of some scholars such as Townsend (1979), Streeten (1981) and Sen (1992), highlighted that the well-being of an individual, and hence inequality and poverty of a population, is dependent on many dimensions of human life, such as housing, education, life expectancy, and income is just one of these dimensions. In this framework poverty is better defined as a situation that reflects failures in different dimensions of human well-being.

Second, in the income distribution literature income is not important *per se* but it is supposed to be a measure of an individual's command over economic resources. As such it is not always a good measure since it neglects command over resources out of wealth, non-cash transfers from the government and support from family and friends. (For a discussion on this point see, among others, Ringen, 1988.) To measure command over economic resources insufficient to reach a decent standard of living, aspects in addition to income should be included. In this process it is necessary to distinguish the absence of consumption of a good due to individual preferences or that due to inability to afford. Obviously, the first case should not be considered in the poverty measure. In addition, for policy purposes, it is necessary to identify the fragment of the population who is currently poor. In the dataset, the information on income collected regards the previous calendar year (and is more likely to be misreported—particularly, underreported) while items of consumption are contemporaneously reported.

The third reason concerns particularly the European Union member states. Within the EU, the shift in policy focus from pure income poverty towards a wider multidimensional deprivation framework is particularly intense. Changes in public policies implemented by the member states were initiated at the March 2000 Lisbon European Council. At this Council the member states agreed to adopt the Open Method of Coordination which involves the definition of a set of common objectives on poverty and social exclusion for the EU as a whole. The Laeken European Council in December 2001 endorsed a first set of 18 indicators (now known as the Laeken indicators) to evaluate the well-being of the population. Among the so-called primary indicators are not only measures of income poverty and inequality but also life expectancy at birth, health status, unemployment and early school leavers. "Member States are expected to use at least the primary indicators in

their national strategy reports, if only to emphasise that in the context of the EU social inclusion process poverty and social exclusion are a relative concept that encompasses income, access to essential durables, education, health care, adequate housing, distance from the labour market." (European Commission, p.16.)

The European Union distinguishes itself from other countries with a clear endorsement of the relative concept of poverty. The measures of income poverty within the Laeken indicators are based on member specific poverty lines, that is, for each member state the income threshold depends on the income distribution of the specific country and does not take into account inequality between member states (see Section 4 for details). This practice has become more problematic with the enlargement of the Union and the wide differences existing between the income distributions of old and new member states. Someone poor in one of the old member states will be richer than average in a new member state. Should the rich be taxed and the poor receive the transfer? This is clearly a paradoxical situation. Hence, other indicators of the quality of life of an individual are necessary to evaluate the well-being of a EU resident. (For a discussion on this point, see, among others, Fahey, 2007, and Whelan, Nolan and Maître, 2008.) To distinguish these multidimensional indicators from pure income poverty measures, the term *material deprivation* measures is used.

This shift of emphasis towards multidimensionality has raised many challenges for social scientists interested in measuring poverty in well-being. The two-stage procedure suggested by Sen (1976)—consisting of first identifying the poor and then aggregating the information available on this segment of the population into an index of poverty for the entire society—has to be extended.

In the multidimensional framework each person possesses a vector of several attributes that represent different dimensions of well-being. For measuring multidimensional poverty, it then becomes necessary to check whether a person has "minimally acceptable levels" (Sen, 1992, p.139) of these attributes. These minimally acceptable quantities of the attributes represent their threshold limits or cut-offs that are necessary for a subsistence standard of living. Therefore, a person is treated as deprived or poor in a dimension if its consumption level of the dimension falls below its cut-off. In this case we say that the individual is experiencing a functioning failure. Poverty at the individual level is an increasing function of these failures.

The first stage consisting of the identification of the poor in a multivariate framework is still a debatable issue. One obvious way of regarding a person as poor is if it experiences a functioning failure in all dimensions, which enables us to identify the number of poor

as the total number of persons who are poor in all dimensions. This is known as the intersection method of identification of the poor. But if a person is poor in one dimension and non-poor in another, then trading off between the two dimensions may not be possible. Lack of access to essential durables, say, cannot be compensated by housing. Clearly, such a person cannot be regarded as rich. In view of this, a person may be treated as poor if it is poor in at least one dimension. This is the union method of identifying the poor (see Tsui, 2002, and Bourguignon and Chakravarty, 2003). In between these two extremes lies the intermediate identification method which regards a person as poor if it is deprived in at least m dimensions, where $1 \leq m \leq K$, with K being the number of dimensions (or weighted sum of dimensions) on which human well-being depends (see Mack and Lindsay, 1985, Gordon, Nandy, Pantazis, Pemberton and Townsend, 2003, and Alkire and Foster, 2007). Evidently, the intermediate method contains the union and the intersection methods as special cases for $m = 1$ and $m = K$.

In the multivariate framework, the aggregation stage unavoidably becomes a two-step procedure in itself and no agreement has been reached yet on how to proceed. In measuring multidimensional poverty, it is necessary to first aggregate the information regarding the different functioning failures of each individual into a measure of poverty at the individual level, and second to aggregate the latter across individuals to obtain a measure of poverty for the entire society. The axiomatic literature in the unidimensional framework dealt only with the second issue. For surveys on measuring income poverty see, among others, Chakravarty (1990, 2009).

The axiomatic literature has proposed some measures of multidimensional poverty and explored the properties that are at the basis of these indices (see Chakravarty, Mukherjee and Ranade, 1998, Tsui, 2002, Bourguignon and Chakravarty, 2003, Gajdos and Weymark, 2005, Alkire and Foster, 2007, Diez, Lasso de la Vega and Urrutia, 2008, Lasso de la Vega, Urrutia and de Sarachu, 2008, Chakravarty and D'Ambrosio, 2009, Decancq and Lugo, 2009). But with the exception of Alkire and Foster (2007) the considered functionings have to be of a quantitative type.

Usually, only a few of a survey's variables on individual well-being are quantitative in nature. This situation is common to many surveys; see, for example, the European Community Household Panel or the more recent EU Statistics on Income and Living Conditions (EU-SILC) for EU countries, the United States' Current Population Survey, where most of the variables that could be used to measure multidimensional poverty are qualitative. Hence, most of the indices proposed in the above-mentioned papers cannot be applied. An alternative is what Atkinson (2003) referred to as the *counting* approach.

A counting measure of individual poverty is the number of dimensions in which a person is poor, that is, the number of the individual functioning failures. But this measure treats all the dimensions symmetrically in the sense that in the aggregation of an individual's functioning failures, the same weight (one) is assigned to each dimension. Since some of the dimensions may be more important than others, a more appropriate counting measure can be obtained by assigning different weights to different dimensions and then summing up these weights for the dimensions in which functioning failure is observed. These weights may be assumed to reflect the importance a policy maker attaches to alternative dimensions in a poverty alleviation proposal. For instance, for evaluating multidimensional poverty in Mexico, Foster (2007) assumed a weight structure which first splits weights between income and non-income dimensions equally and then uses equal weights for non-income dimensions. Alternatively, the weights may reflect views of the society under analysis which is the approach followed in the present contribution (see Section 4 for details.).

The first aim of this paper is to characterize a class of individual counting measures of multidimensional poverty and material deprivation that allows for the assignment of different weights to the considered dimensions. An advantage of our method is that it can be applied even if the data set contains both qualitative and quantitative variables. It should be clear that the calculation of the individual measure does not depend on any specific method of identification of the poor. More precisely, whatever the method of identification of the poor, our measures can be calculated. Hence our contribution is on the aggregation stage mentioned above. We proceed further by axiomatizing a class of aggregate poverty measures that permit us to compare different societies with respect to the poverty suffered by their members. We wish to take into account inequality in the distribution of individual poverty. The resulting distribution-sensitive measures are the extended symmetric means of order $r \geq 1$ applied to the individual multidimensional poverty values. The restriction on the possible values of the parameter r is a consequence of requiring inequality aversion with respect to individual poverty.

The last part of this paper aims at measuring material deprivation in the European Union using the same dataset, EU-SILC, which allows member states and the Commission to monitor national and EU progress towards key objectives for the social inclusion process. The weights for the different dimensions are obtained from a survey of EU citizens as reported in the special Eurobarometer 279 on poverty and social exclusion conducted in 2007 on behalf of the European Commission for the preparation of the 2009 thematic module on material deprivation of EU-SILC.

2 Individual Measures

Suppose there are $K \in \mathbb{N}\backslash\{1\}$ attributes that are relevant for the degree of well-being of an individual, such as housing conditions, access to certain goods and services, employment status, ability to satisfy basic needs. These characteristics are the same across societies and represented by binary variables: a value of one indicates that the individual is poor with respect to this attribute, a value of zero identifies a characteristic with respect to which the individual is not poor. Thus, an *individual characteristics vector* is an element of $\mathcal{P} = \{0,1\}^K$ and an *individual multidimensional poverty measure for individual i* is a function $P_i: \mathcal{P} \to \mathbb{R}$. This paper is concerned with the aggregation of individual poverty over characteristics and the across-society aggregation of these individual measures into a social measure of multidimensional poverty. We begin with a discussion of individual multidimensional poverty.

Let $\mathbf{0}$ be the vector consisting of K zeroes and, for all $j \in \{1,\ldots,K\}$, let $\mathbf{1}^j$ be the K-dimensional j^{th} unit vector, defined by

$$\mathbf{1}^j_k = \begin{cases} 1 & \text{if } k = j \\ 0 & \text{if } k \neq j. \end{cases}$$

We require P_i to possess the following properties.

Zero normalization. For all $j \in \{1,\ldots,K\}$,

$$P_i(\mathbf{1}^j) > P_i(\mathbf{0}) = 0.$$

Additive decomposability. For all $x, y \in \mathcal{P}$ such that $(x+y) \in \mathcal{P}$,

$$P_i(x+y) = P_i(x) + P_i(y).$$

The normalization assumption is very standard: when the individual is not poor in any attribute we require the value of the index to be zero. The additive decomposability property we use is very straightforward as well. Many social index numbers have an additive structure.

Additive decomposability entails a separability property: the contribution of any variable to the overall index value can be examined in isolation, without having to know the values of the other variables. In other words, if an individual is poor in some attributes as indicated by the vector x and becomes also poor in other attributes according to the vector y then its individual poverty will be simply given by the sum of the poverty values

reached separately under x and y. Thus, additive decomposability properties are often linked to independence conditions of various forms. Note that, because of the finite domain considered here, an independence condition is not sufficient unless there are at most four dimensions to poverty; this can be seen by adapting the corresponding result in Kraft, Pratt and Seidenberg (1959) to our setting. Because we work with a general number of poverty attributes and, moreover, the data set used in our application covers well over four attributes, the full force of additive decomposability is required in our characterization of the individual generalized counting measure.

The above two properties characterize the class of measures identified in the following theorem.

Theorem 1 *An individual multidimensional poverty measure P_i satisfies zero normalization and additive decomposability if and only if there exists $\alpha \in \mathbb{R}^K_{++}$ such that, for all $x \in \mathcal{P}$,*

$$P_i(x) = \begin{cases} 0 & \text{if } x = \mathbf{0} \\ \sum_{j \in \{1,\ldots,K\}: x_j = 1} \alpha_j & \text{if } x \neq \mathbf{0}. \end{cases} \tag{1}$$

Proof. 'If.' Clearly, the measures defined in (1) satisfy the required axioms.

'Only if.' Suppose P_i satisfies zero normalization and additive decomposability. That $P_i(\mathbf{0}) = 0$ follows immediately from the equality in zero normalization. Define, for all $j \in \{1, \ldots, K\}$, $\alpha_j = P_i(\mathbf{1}^j)$. By the inequality in the definition of zero normalization, it follows that $\alpha_j > 0$ for all $j \in \{1, \ldots, K\}$. Finally, consider the case in which $x \neq \mathbf{0}$. Writing x as

$$x = \sum_{\substack{j \in \{1,\ldots,K\}: \\ x_j = 1}} \mathbf{1}^j,$$

additive decomposability requires

$$P_i(x) = \sum_{\substack{j \in \{1,\ldots,K\}: \\ x_j = 1}} P_i(\mathbf{1}^j) = \sum_{\substack{j \in \{1,\ldots,K\}: \\ x_j = 1}} \alpha_j$$

which completes the proof. ■

3 Aggregate Measures

Given the individual multidimensional poverty measures P_i for each individual in a society, we use an *aggregate multidimensional poverty index* to obtain an overall measure

of poverty that allows us to compare multidimensional poverty across societies. In the comparison among societies we want to take into account inequality in the distribution of individual poverty. For a discussion of distribution-sensitive multidimensional poverty indices in the case of quantitative variables see Tsui (2002). The more equally distributed the latter is, the lower aggregate poverty. For instance, consider two societies, A and B, where two attributes are equally relevant for the evaluation of individual well-being. Suppose that, while in society A only one individual is poor in both attributes, in society B there are two individuals poor in one attribute each. Is multidimensional poverty the same in A and B? This does not necessarily seem to be the case—poverty could be more severe in society A than in B if equity considerations are taken into account.

We proceed by implicitly assuming that the individual aggregation across poverty dimensions is performed first and the second step consists of aggregating the resulting indicators across individuals in a society to arrive at an overall measure of multidimensional poverty. This choice is motivated primarily by our desire to keep the exposition simple. To describe the second part of the aggregation process, let $\mathcal{N} = \mathbb{N} \setminus \{1, 2\}$ and $\Omega = \cup_{n \in \mathcal{N}} \mathbb{R}^n_+$. Now consider a function $\mathbf{P}\colon \Omega \to \mathbb{R}_+$, to be interpreted as a measure that assigns an aggregate value of multidimensional poverty $\mathbf{P}(\mathbf{p})$ to each vector of individual poverty values $\mathbf{p} = (p_1, \ldots, p_n) \in \Omega$, where $n \in \mathcal{N}$ is the population size corresponding to $\mathbf{p}$. For all $n \in \mathcal{N}$, the restriction of $\mathbf{P}$ to $\mathbb{R}^n_+$ is denoted by $\mathbf{P}^n$.

The aggregate multidimensional poverty measures we propose are the *extended symmetric means of order* $r \geq 1$ of individual multidimensional poverty indices, that is, we employ the indices $\mathbf{P}_r$ defined by

$$\mathbf{P}_r(\mathbf{p}) = \left(\frac{1}{n} \sum_{i=1}^{n} p_i^r \right)^{1/r} \tag{2}$$

for all $n \in \mathcal{N}$ and for all $\mathbf{p} \in \mathbb{R}^n_+$. Note that we exclude all values of the parameter r that are less than one. This is the case because the corresponding means fail to be *S-convex,* where S-convexity is the requirement that individuals be treated impartially and aggregate poverty is inequality averse in individual poverty levels. For $r = 1$, the index is the arithmetic mean of the individual poverty levels, which represents the case of a neutral attitude towards poverty inequality.

For $n \in \mathcal{N}$, let $\mathbf{1}_n$ denote the vector consisting of n ones. An $n \times n$ matrix B is *bistochastic* if all its entries are between zero and one and all rows and columns sum to one. We employ the following axioms in our characterization of the extended symmetric means of order r. The first five of these are well-established and require no further

discussion.

Equality normalization. For all $n \in \mathcal{N}$ and for all $a \in \mathbb{R}_+$,

$$\mathbf{P}^n(a\mathbf{1}_n) = a.$$

Continuity. For all $n \in \mathcal{N}$, $\mathbf{P}^n$ is continuous.

Monotonicity. For all $n \in \mathcal{N}$, $\mathbf{P}^n$ is strictly increasing.

S-convexity. For all $n \in \mathcal{N}$, for all $\mathbf{p} \in \mathbb{R}^n_+$ and for all bistochastic $n \times n$ matrices B,

$$\mathbf{P}^n(B\mathbf{p}) \leq \mathbf{P}^n(\mathbf{p}).$$

Linear homogeneity. For all $n \in \mathcal{N}$, for all $\mathbf{p} \in \mathbb{R}^n_+$ and for all $\lambda \in \mathbb{R}_{++}$,

$$\mathbf{P}^n(\lambda\mathbf{p}) = \lambda\mathbf{P}^n(\mathbf{p}).$$

Let, for any $n \in \mathcal{N}$, for any $\mathbf{p} \in \mathbb{R}^n_+$ and for any non-empty proper subset I^s of $\{1, \ldots, n\}$, $\mathbf{p}^s$ be the subvector of $\mathbf{p}$ corresponding to the elements of I^s and let $\mathbf{p}^c$ be the subvector of $\mathbf{p}$ indexed by the elements of the complement $I^c = \{1, \ldots, n\} \setminus I^s$ of I^s. A non-empty proper subset I^s of $\{1, \ldots, n\}$ is *strictly separable from its complement* I^c *in* $\mathbf{P}^n$ if and only if, for all $\mathbf{p}, \mathbf{q} \in \mathbb{R}^n_+$,

$$\mathbf{P}^n(\mathbf{p}^s, \mathbf{p}^c) \geq \mathbf{P}^n(\mathbf{q}^s, \mathbf{p}^c) \;\Leftrightarrow\; \mathbf{P}^n(\mathbf{p}^s, \mathbf{q}^c) \geq \mathbf{P}^n(\mathbf{q}^s, \mathbf{q}^c).$$

Complete strict separability. For all $n \in \mathcal{N}$, any non-empty proper subset of $\{1, \ldots, n\}$ is strictly separable from its complement in $\mathbf{P}^n$.

Complete strict separability requires that the effect of each group of variables on the value of a function can be determined in isolation, without explicit knowledge of the values of the remaining variables. This is a feature shared by all separability properties. It is often formulated as an independence condition: the influence of a group of variables can be assessed independently of the values of the complementary variables. In other words, when comparing two distributions, individuals with the same poverty in either distribution do not influence aggregate comparisons of both distributions, no matter their level of poverty. See Blackorby, Primont and Russell (1978) for a detailed discussion of complete strict separability and generalizations of this property.

Poverty Wicksell population principle. For all $n \in \mathcal{N}$ and for all $\mathbf{p} \in \mathbb{R}^n_+$,

$$\mathbf{P}^{n+1}(\mathbf{p}, \mathbf{P}^n(\mathbf{p})) = \mathbf{P}^n(\mathbf{p}).$$

The poverty Wicksell population principle establishes a link between societies with different population sizes. It requires that the ceteris-paribus addition of an individual with aggregate poverty to a given society does not change overall poverty. Intuitively, this implies that variable-population comparisons are based on average poverty rather than on total poverty or other aggregation methods across population sizes. See Blackorby and Donaldson (1984) for a discussion of this property and its link to general averaging principles.

We obtain

Theorem 2 *A function* $\mathbf{P}\colon \Omega \to \mathbb{R}_+$ *satisfies equality normalization, continuity, monotonicity, S-convexity, linear homogeneity, complete strict separability and the poverty Wicksell population principle if and only if there exists* $r \geq 1$ *such that* $\mathbf{P} = \mathbf{P}_r$.

Proof. The 'if' part of the theorem statement is straightforward to verify. To prove the 'only if' part, suppose $\mathbf{P}$ satisfies the required axioms.

Consider first the fixed-population-size case. It is well-known that, for any $n \in \mathcal{N}$, the class of symmetric means of order $r_n \geq 1$ is characterized by the fixed-population restrictions of the axioms equality normalization, continuity, monotonicity, S-convexity, linear homogeneity and complete strict separability; see, for instance, Hardy, Littlewood and Pólya (1934) and Kolm (1976), among others. Note that the possible values of the parameter r_n are restricted due to our assumption of S-convexity. Furthermore, note that, without invoking additional properties, the parameter r_n can depend on the population size n and only vectors of dimension n can be compared according to $\mathbf{P}^n$. Thus, we have, for all $n \in \mathcal{N}$ and for all $\mathbf{p} \in \mathbb{R}^n_+$,

$$\mathbf{P}^n(\mathbf{p}) = \left(\frac{1}{n} \sum_{i=1}^{n} p_i^{r_n} \right)^{1/r_n}$$

where this function can be used to compare vectors of population size n.

We complete the proof of the theorem by using the poverty Wicksell population principle to establish that the r_n must be identical for all n and that the resulting function $\mathbf{P}$ can be employed in the comparison of any two vectors of different dimensions as well.

Let $n \in \mathcal{N}$ and define $r = r_{n+1}$. Thus,

$$\mathbf{P}^{n+1}(\mathbf{p}) = \left(\frac{1}{n+1} \sum_{i=1}^{n+1} p_i^{r} \right)^{1/r} \tag{3}$$

for all $\mathbf{p} \in \mathbb{R}^{n+1}_+$.

Now let $\mathbf{p} \in \mathbb{R}^n_+$. By the poverty Wicksell population principle and (3), we must have

$$\begin{aligned} \mathbf{P}^n(\mathbf{p}) &= \mathbf{P}^{n+1}\left(\mathbf{p}, \mathbf{P}^n(\mathbf{p})\right) \\ &= \left(\frac{1}{n+1}\left(\sum_{i=1}^{n} p_i^r + \left(\mathbf{P}^n(\mathbf{p})\right)^r\right)\right)^{1/r} \end{aligned}$$

and, solving for $\mathbf{P}^n(\mathbf{p})$, we obtain $\mathbf{P}^n(\mathbf{p}) = \mathbf{P}_r^{n+1}(\mathbf{p})$. Thus, the same parameter value r can be used for population size n and for population size $n+1$. Because this is true for all values of n, $\mathbf{P}$ is an extended symmetric mean of order $r \geq 1$, as was to be established. ■

4 Material Deprivation within the EU

The purpose of this section is to illustrate the poverty index $\mathbf{P}_r$, as defined in (2), using EU-SILC, the dataset used by European Union member states and the Commission to monitor national and EU progress towards key objectives for the social inclusion process. We base our analysis on the last two surveys of available cross-sectional data, 2005 and 2006, in order to maximize the number of included countries (in our dataset 23 EU member states plus Norway and Iceland). We decided not to consider 2004, the year when the survey started, since only few member states participated in that year. Unfortunately we did not have access to data on the Netherlands for bureaucratic reasons. EU-SILC is an annual survey which provides comparable, cross-sectional and longitudinal multidimensional data on living conditions in the European Union. The variables that could be used to measure multidimensional poverty are available mainly at the household level. At the individual level we have information only on education and health. The presence of many missing values in the latter would compromise the results and, for this reason, we concentrate on variables at the household level where the problem of missing values is less severe. We decided to follow a conservative approach since we treated the households reporting a missing value as those reporting not to have the functioning failure. As a result, we could be underestimating material deprivation since we are attributing a functioning failure exclusively to households who explicitly claim to have the failure. The unit of our analysis is the individual, that is, the household failure is attributed to each household member and we analyze the distribution of functioning failures among individuals. The poverty line applied follows the Laeken indicators in being 60% of the median of the distribution of equivalent income in each country. The equivalence scale applied is the modified OECD equivalence scale. This scale gives a weight of 1.0 to the

first adult, 0.5 to any other household member aged 14 and over and 0.3 to each child below the age of 14. The estimations use provided sample weights. The non-monetary variables considered in the measures of material deprivation are the following:

1. The dwelling has a leaking roof, damp walls/floors/foundations, or rot in doors, window frames or floor.
2. The household lacks the ability to keep the home adequately warm.
3. The dwelling does not have a proper room with a bath or shower.
4. The dwelling does not have an indoor flushing toilet for the sole use of household.
5. The household has been in arrears at any time in the last 12 months on mortgage or rent payments.
6. The household has been in arrears at any time in the last 12 months on utility bills.
7. The household has been in arrears at any time in the last 12 months on hire purchase instalments or other loan payments.
8. The household cannot afford to pay for a one-week annual holiday away from home.
9. The household cannot afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day.
10. The household lacks the capacity to face unexpected required expenses.
11. The household cannot afford a telephone (including mobile phone).
12. The household cannot afford a colour TV.
13. The household cannot afford a computer.
14. The household cannot afford a washing machine.
15. The household cannot afford to have a car.
16. The dwelling has noise from neighbours or noise from the street.
17. The household lives in an area with pollution, grime or other environmental problems caused by traffic or industry.

18. The household lives in an area with crime, violence or vandalism.

The weights are constructed from the views of EU citizens as surveyed in 2007 in the special Eurobarometer 279 on poverty and social exclusion. This weighing method has first been proposed by Fusco, Guio and Marlier (2009). Part of the survey is aimed at understanding what Europeans regard necessary in order to have a decent standard of living with regards to financial means, housing needs, ownership of durable goods and basic necessities. The sample is composed of 26,466 EU citizens aged 15 and over living in the 27 European Union Member States and 1,000 residents of Croatia. Since the special Eurobarometer was commissioned by the European Commission for the preparation of the 2009 thematic module on material deprivation of EU-SILC, all the non-monetary variables described above and available in EU-SILC are contained in it. The only discrepancy concerns the affordability of a telephone since the Eurobarometer distinguishes between landlines and mobile phones. In this paper we decided to weigh according to the answer given to landline since we believe that it is less problematic not to have access to a mobile phone. For each non-monetary variable we use as weight the percentage of the EU citizens answering "absolutely necessary, no one should have to do without" to the following "In the following questions, we would like to understand better what, in your view, is necessary for people to have what can be considered as an acceptable or decent standard of living in (OUR COUNTRY). For a person to have a decent standard of living in (OUR COUNTRY), please tell me how necessary do you think it is ... (if one wants to)". The potential answers included also "necessary", "desirable but not necessary" and "not at all necessary". Table 1 lists the official abbreviations of country names that we use in the remaining tables and figures. The answers given by citizens living in EU27 are reported in Table 2. The weights used in this paper are contained in column 2. They range from 69% for the absolutely necessity of an indoor flushing toilet for the sole use of the household to 9% for the absolutely necessity of affordability of a computer. We compare the results with that obtained computing indices where all failures are weighed equally.

Insert Tables here

Results of the analysis for 2005 are contained in Table 3 while those for 2006 are in Table 4. In Figures 1 and 2 we plot the change in the rankings as opposed to those obtained according to the headcount on household equivalent income. A very different picture emerges confirming that income poverty and material deprivation differ considerably among European countries (on similar findings, see among others Fusco, Guio and

Marlier, 2009, Whelan and Maître, 2009). European social policy aiming at assisting citizens with low well-being should better be performed complementing information on both income poverty and material deprivation. Ireland, Luxembourg, the UK and Spain are the countries which considerably improve their position in both years, while for the Republic of Cyprus, the Czech Republic, Slovenia and Slovakia we observe the reverse phenomenon. On average, changes in the inequality aversion parameter, r, do not produce a relevant effect showing that the differences among the countries are stable to various perturbations. This is also the case when we compute the indices using the alternative equal weighting scheme. Here the greatest effect occurs for Iceland and Slovakia. Iceland's position improves by two when equal weighting is given to all dimensions while Slovakia moves down in the rankings by three positions (with one exception in 2005).

Insert Figures here

5 Conclusion

In this paper we provide a theoretical foundation of the most popular index of multidimensional poverty and material deprivation computed on available data, namely, the average weighted sum of functionings failures. At the aggregate (societal) level, we suggest a way to include considerations on inequality in the distribution of the index at the individual level. In addition to the arithmetic mean (represented by a parameter value of $r = 1$), symmetric means of order greater than one are included in our characterization. The higher the order of the mean r, the more inequality averse is the resulting aggregate poverty measure.

Our index resembles Bourguignon and Chakravarty's (2003) index for measuring multidimensional poverty in the case of quantitative variables. The exact generalization of the latter to the case of quantitative variables could be obtained by imposing decomposability among population subgroups in our framework. We leave this for future research.

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Tables and Figures

Table 1: Official Abbrevations of Country Names.

AT Austria	CZ Czech Republic	EL Greece	IE Ireland	LU Luxembourg	NO Norway	SI Slovenia
BE Belgium	DK Denmark	ES Spain	IS Iceland	LV Latvia	PL Poland	SK Slovakia
BG Bulgaria	DE Germany	FI Finland	IT Italy	HU Hungary	PT Portugal	SE Sweden
CY Republic of Cyprus	EE Estonia	FR France	LT Lithuania	MT Malta	RO Romania	UK The United Kingdom

Table 2: Answers in percentages to: "In the following questions, we would like to understand better what, in your view, is necessary for people to have what can be considered as an acceptable or decent standard of living in (OUR COUNTRY). For a person to have a decent standard of living in (OUR COUNTRY), please tell me how necessary do you think it is...(if one wants to)".

EU27	Absolutely necessary, no one should have to do without	Necessary	Desirable but not necessary	Not at all necessary
A place to live without a leaking roof, damp walls, floors, foundation	68%	28%	3%	1%
To be able to keep one's home adequately warm	62%	35%	3%	0%
A place to live with its own bath or shower	63%	31%	6%	0%
An indoor flushing toilet for sole use of the household	69%	27%	4%	0%
To be able to pay rent or mortgage payments on time	62%	34%	3%	0%
To be able to pay utility bills (electricity, water, gas, etc.) on time	68%	30%	2%	0%
To be able to repay loans (such as loans to buy electrical appliances, furniture, a car or student loans, etc.) on time	48%	40%	9%	2%
Paying for one week annual holiday away from home	15%	29%	43%	13%
A meal with meat, chicken or fish at least once every two days	43%	37%	17%	3%
To be able to cope with an unexpected financial expense of X (NATIONAL CURRENCY)	32%	43%	21%	2%
A fixed telephone, landline	18%	37%	32%	13%
A mobile phone	12%	26%	37%	25%
A colour TV	19%	36%	35%	10%
A computer	9%	21%	41%	28%
A washing machine	48%	41%	10%	1%
A car	17%	34%	36%	13%
A place to live without too much noise from neighbours or noise from the street (traffic, businesses, factories, etc.)	28%	43%	27%	2%
A place to live without too much pollution or other environmental problems (such as air pollution, grime or rubbish)	42%	44%	13%	1%
A place to live without crime, violence or vandalism in the area	49%	38%	12%	1%

Table 3: Material Deprivation and Income Poverty in EU Member States in 2005, with Eurobarometer Weights (Euro) and with Unitary (No) Weights for Different Values of r.

2005	Headcount	Euro r =1		Euro r =1.5		Euro r =2		No r =1		No r =1.5		No r =2	
Country	Rank	Rank	Change	Rank	Change	Rank	Change	Rank	Change	Rank	Change	Rank	Change
SE	1	1	0	1	0	1	0	1	0	1	0	1	0
IS	2	9	7	9	7	8	6	6	4	6	4	6	4
CZ	3	16	13	16	13	16	13	16	13	16	13	16	13
NO	4	2	-2	2	-2	3	-1	2	-2	2	-2	2	-2
FI	5	7	2	6	1	6	1	8	3	7	2	7	2
DK	6	3	-3	4	-2	5	-1	3	-3	3	-3	3	-3
SI	7	14	7	14	7	14	7	13	6	14	7	14	7
DE	8	8	0	8	0	7	-1	9	1	9	1	8	0
AT	9	4	-5	3	-6	2	-7	5	-4	5	-4	5	-4
FR	10	11	1	12	2	12	2	12	2	12	2	13	3
LU	11	5	-6	5	-6	4	-7	4	-7	4	-7	4	-7
SK	12	18	6	17	5	17	5	20	8	20	8	20	8
HU	13	22	9	22	9	22	9	22	9	22	9	22	9
BE	14	12	-2	13	-1	13	-1	10	-4	11	-3	12	-2
CY	15	21	6	20	5	20	5	19	4	19	4	19	4
EE	16	20	4	21	5	21	5	21	5	21	5	21	5
IT	17	15	-2	15	-2	15	-2	15	-2	15	-2	15	-2
UK	18	10	-8	10	-8	10	-8	11	-7	10	-8	10	-8
LV	19	25	6	25	6	25	6	25	6	25	6	25	6
PT	20	17	-3	18	-2	18	-2	17	-3	17	-3	17	-3
GR	21	19	-2	19	-2	19	-2	18	-3	18	-3	18	-3
IE	22	6	-16	7	-15	9	-13	7	-15	8	-14	9	-13
ES	23	13	-10	11	-12	11	-12	14	-9	13	-10	11	-12
LT	24	24	0	24	0	24	0	24	0	24	0	24	0
PL	25	23	-2	23	-2	23	-2	23	-2	23	-2	23	-2

Table 4: Material Deprivation and Income Poverty in EU Member States in 2006, with Eurobarometer Weights (Euro) and without (No) Weights for Different Values of r.

2006	Headcount	Euro r =1		Euro r =1.5		Euro r =2		No r =1		No r =1.5		No r =2	
Country	Rank	Rank	Change	Rank	Change	Rank	Change	Rank	Change	Rank	Change	Rank	Change
IS	1	7	6	7	6	7	6	5	4	4	3	4	3
CZ	2	16	14	16	14	16	14	16	14	16	14	16	14
NO	3	1	-2	2	-1	3	0	1	-2	2	-1	3	0
SK	4	17	13	17	13	17	13	20	16	20	16	20	16
SI	5	14	9	14	9	14	9	13	8	13	8	13	8
DK	6	4	-2	6	0	6	0	4	-2	5	-1	5	-1
SE	7	2	-5	1	-6	1	-6	2	-5	1	-6	1	-6
FI	8	6	-2	5	-3	4	-4	7	-1	7	-1	7	-1
AT	9	5	-4	4	-5	5	-4	6	-3	6	-3	6	-3
DE	10	13	3	13	3	13	3	14	4	14	4	14	4
FR	11	10	-1	10	-1	11	0	11	0	11	0	11	0
LU	12	3	-9	3	-9	2	-10	3	-9	3	-9	2	-10
BE	13	11	-2	12	-1	12	-1	10	-3	10	-3	10	-3
CY	14	22	8	22	8	21	7	21	7	21	7	21	7
HU	15	21	6	21	6	22	7	22	7	22	7	22	7
EE	16	20	4	20	4	20	4	19	3	19	3	19	3
PT	17	18	1	18	1	18	1	18	1	18	1	18	1
IE	18	8	-10	9	-9	9	-9	9	-9	9	-9	9	-9
PL	19	23	4	23	4	23	4	23	4	23	4	23	4
UK	20	9	-11	8	-12	8	-12	8	-12	8	-12	8	-12
IT	21	15	-6	15	-6	15	-6	15	-6	15	-6	15	-6
ES	22	12	-10	11	-11	10	-12	12	-10	12	-10	12	-10
LT	23	24	1	24	1	24	1	24	1	24	1	24	1
GR	24	19	-5	19	-5	19	-5	17	-7	17	-7	17	-7
LV	25	25	0	25	0	25	0	25	0	25	0	25	0

Figure 1: Material Deprivation and Income Poverty in EU Member States in 2005, with Eurobarometer Weights (Euro) and Unitary (No) Weights for Different Values of r.

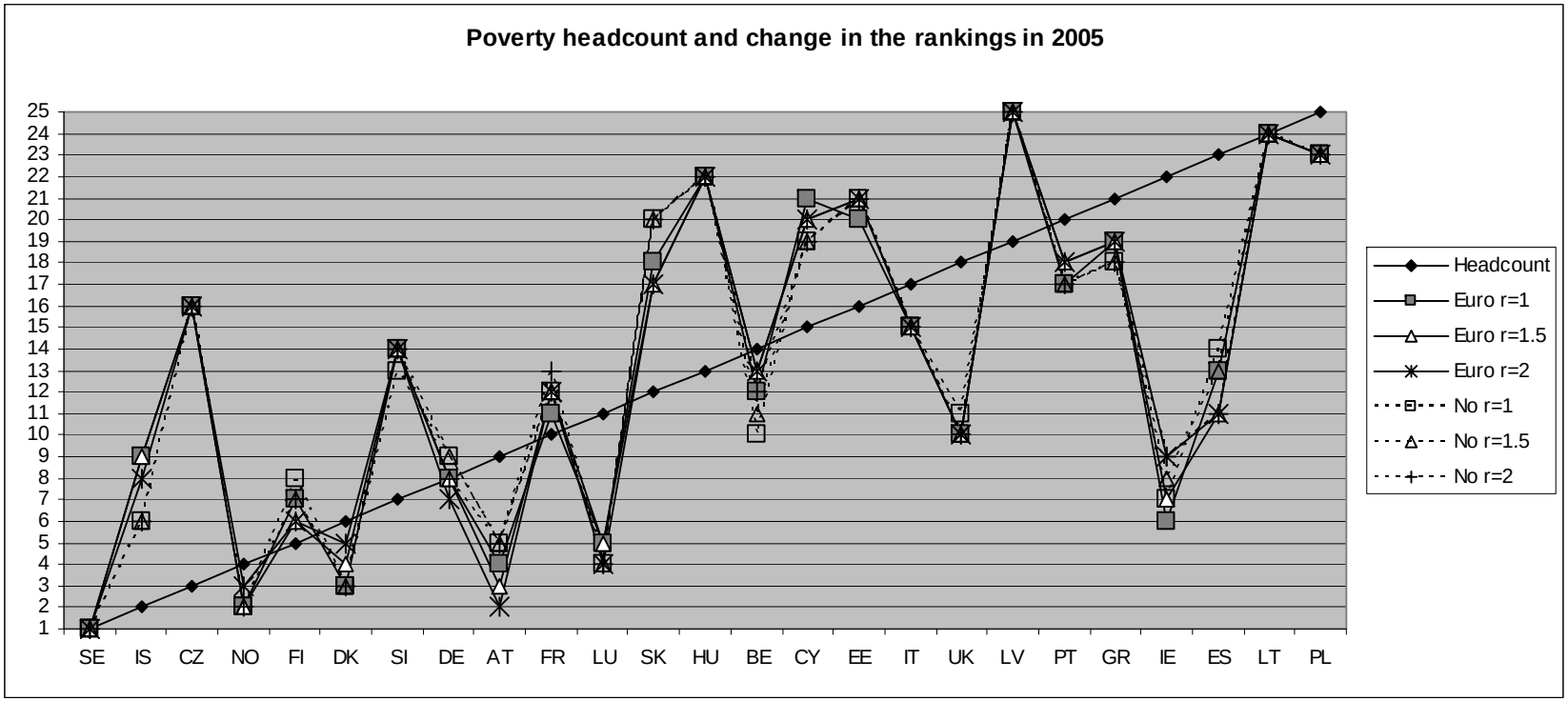

Figure 2: Material Deprivation and Income Poverty in EU Member States in 2006, with Eurobarometer Weights (Euro) and without (No) Weights for Different Values of r.